EMS Annual Meeting Abstracts
Vol. 7, EMS2010-604, 2010
10th EMS / 8th ECAC

JEM-EUSO: an opportunity for carrying out researches in atmospheric physics, meteorology and climatology using remote sensing techniques from space

C. Cassardo (1,2)

(1) University of Torino, Dept. of General Physics "A. Avogadro", Torino, Italy (claudio.cassardo@unito.it, +39-011-658-444), (2) For the JEM-EUSO Collaboration

JEM-EUSO, with a large and wide-angle (60°) telescope mounted on the International Space Station, has been planned as a space mission to explore the extreme universe through the investigation of extreme energy cosmic rays ($E>10^{20}$eV) by detecting the fluorescence and Cherenkov lights which accompany air showers developed in the earth's atmosphere. The telescope consists of high transmittance optical Fresnel lenses with a diameter of 2.5m, 200k channels of multianode-photomultiplier tubes, front-end readout, and trigger and system electronics. In order to monitor the optical yield of the atmosphere, an infrared camera and a LIDAR system will be also coupled to the main telescope forming the Atmosphering Monitoring System (AMS) of the mission. The IR camera consists of Ge dioptric lenses, a band-pass filter and an un-cooled micro-bolometer array. It will acquire images of the cloud top temperature of opaque clouds covering the JEM-EUSO field-of-view (FOV), allowing the low-precision determination of their top altitude. High-precision (30m) Lidar cloud-top altitude measurements will be used to correct the cloud-top altitude from the IR-camera. The Lidar detection will be based on a laser at 355 nm, transmitted in several fixed directions, providing fixed traces of precise ranging of the cloud top, parallel to the projection of the International Space Station orbit on the surface. In addition to opaque clouds, the Lidar will also optically detect thin cirrus clouds that are of particular interest in atmospheric science. The UV optical background signal, detected by JEM-EUSO in its "slow-mode", combined with "stereoscoping" processing will also provide low-resolution evaluation of the cloud top altitude. The potential of the AMS is adequate for correction of the atmospheric factors in the evaluation of the optical yield of the particle trace. In synthesis, the AMS will provide a 3D map of the opaque cloud cover inside the FOV of the JEM-EUSO sensor, i.e, the presence of clouds in the respective pixels and the cloud-top altitude.

Thus, besides providing valuable information for the Extreme Energy Cosmic Ray observation from space, the potential of the AMS could be very effective in observing poor studied transient atmospheric phenomena and in addressing research on other relevant questions in atmospheric physics that are yet without answers. Among these, we could quote: monitoring cloud coverage; monitoring air transparency by detecting aerosol and subvisible clouds layers; creating 3D cloud maps, by evaluating top, depth and other cloud properties, and interpreting their dynamics; carrying out micro-meteors statistics; studying gravity waves; understanding space-atmosphere interactions and possibly related climate changes; improving the knowledge on mesoscale convective system; finding the aerosols distribution in lower atmosphere and establishing their role in provoking thunderstorms; impact phenomena of meteorites and interaction of dust with clouds and radiative properties in the atmosphere; monitoring and understanding light transient phenomena (elves, sprites, terrestrial gamma flashes and generally atmospheric discharge phenomena) with their possible impact on aviation safety).

The expected benefits of this unique effort will have long-lasting effects on fundamental physics of high energies and important relapses on atmospheric physics science.